U.S. NUCLEAR REGULATORY COMMISSION

REGION II

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Licensee:	Florida Power Corporation
Facility:	Crystal River 3 Nuclear Station
Location:	15760 West Power Line Street Crystal River, FL 34428-6708
Dates:	June 22 through June 26, 1998
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EXECUTIVE SUMMARY

Crystal River 3 Nuclear Station
NRC Inspection Report 50-302/98-03

This inspection included a review of the licensee's implementation of 10 CFR 50.65. "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants" [the Maintenance Rule]. The report covers a one-week period of inspection.

- Overall. the inspection team concluded that the licensee's Maintenance Rule met the requirements of 10 CFR 50.65. and the program was being adequately implemented. Although the program was being adequately implemented. weaknesses were identified indicating the need for improvements.

Operations

- Licensed operators had an adequate understanding of the Maintenance Rule and understood their responsibilities for implementing the Maintenance Rule. The work control senior reactor operators (SROs). work week supervisors and schedulers were familiar with the use of the probablistic safety assessment (PSA) monitor in support of work control activities. (Section 04.1)

Maintenance

- Required structures. systems. and components (SSCs). with the exception of one structure. were included within the scope of the Rule. (Section M1.1)

- The (a)(3) periodic assessment met the requirements of paragraph (a)(3) of 10 CFR 50.65. (Section M1.3)

- The licensee's approach of balancing reliability and unavailability met the intent of paragraph (a)(3) of 10 CFR 50.65. (Section M1.4)

- For the (a)(1) SSCs reviewed. the licensee had established goals and monitoring. Safety had been considered in establishment of the goals and monitoring. Operating experience was being captured and industry wide operating experience was used. Corrective actions for improving the performance of (a)(1) SSCs were appropriate. (Section M1.6)

- Generally. for (a)(2) SSCs. performance criteria was established: industry-wide operating experience was considered. where practical: operating data was being captured: appropriate trending was being performed: and corrective action was taken when SSCs failed to meet performance criteria. or when a SSC experienced a maintenance preventable functional failure. However. a violation was identified for failure to count unavailability time during surveillance testing of some risk-significant SSCs. (Section M1.7)

- Overall, the Maintenance Rule structures program was considered a strength. A detailed and thorough inspection of Maintenance Rule structures had been performed and documented. (Section M1.7)

- Generally, plant material condition observed during walkdowns was good. (Section M2.1)

- Maintenance Rule audits and assessments were thorough. Corrective actions were adequate with the exception of three issues which had been identified but not unresolved for over nine months. This corrective action delay was considered to be a weakness. (Section M7.1)

<u>Engineering</u>

- The overall quantitative approach used to perform risk-ranking of SSCs for the Maintenance Rule was acceptable. The Delphi approach used in the expert panel decision-making on SSC safety significance did not result in any improper ranking of SSCs. The bases for all expert panel decisions were well documented. (Section M1.2)

- Modeling problems in the sensitivity analysis and the licensee-identified problem of not adequately linking the performance criteria to PSA assumptions were considered weaknesses in establishment of performance criteria. (Section M1.2)

- The overall approach, under paragraph (a)(3) of the Rule, to assessing the risk impact to maintenance activities was acceptable. (Section M1.5)

- The use of the PSA Monitor (PSAM) for online risk evaluation of plant configurations was considered a strength. (Section M1.5)

- The impact of (1) switchyard maintenance, and (2) environmental conditions on SSCs being out of service was not adequately modeled by the PSAM model. This PSAM modeling problem was considered a weakness in evaluating the risk-impact of multiple SSCs. (Section M1.5)

- System engineers demonstrated excellent knowledge of their systems, were proactive in corrective actions, and had a good understanding of the Maintenance Rule requirements and how to apply the Rule to their systems. This area was considered a strength. (Section E4.1)

Report Details

Summary of Plant Status

Crystal River operated at power during the inspection period.

Introduction

The primary focus of this inspection was to verify that the licensee had implemented a maintenance monitoring program which met the requirements of 10 CFR 50.65. "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." (the Maintenance Rule). The inspection was performed by a team of inspectors that included a Team Leader. three Region II Inspectors. one NRR PRA Specialist. one NRR Structural Engineer. and two Resident Inspectors. In addition. NRC staff support was provided by a Reactor Operations Engineer from the Quality Assurance and Maintenance Branch. Office of Nuclear Reactor Regulation (NRR). The licensee provided an overview presentation of the program to the team on the first day of the inspection.

I. OPERATIONS

O4 Operator Knowledge and Performance

O4.1 Operator Knowledge of Maintenance Rule

a. Inspection Scope (62706)

Prior to the onsite portion of the inspection. the team reviewed two months of operation's shift logs. During the onsite portion of the inspection. the team interviewed eight individuals: four SROs (including two licensed operators. a shift technical advisor and an operations manager). a work control shift supervisor. a maintenance planning supervisor. a scheduler. and a work week supervisor. The interviews were conducted to determine if the operators involved in on-shift operations understood the general requirements of the Maintenance Rule and their particular duties and responsibilities for its implementation. From the interviews. the team determined the operators' understanding of the Maintenance Rule. how their current duties were impacted by the Maintenance Rule. and their understanding of how availability was tracked by the Rule.

b. Observations and Findings

In general. the operators interviewed understood the philosophy of the Maintenance Rule and their responsibilities associated with the Rule. The operators all believed that they were adequately trained and understood the requirements of the applicable procedures. All operators understood the need to restore equipment to operating condition and minimize SSC unavailabilities. The interviews indicated that the operations staff was sensitive to the importance of the logs as a source of information for Maintenance Rule record keeping.

The PSAM was a tool used by operators, work week supervisors, and schedulers to assess risk when removing equipment from service. A desktop guide, "PSAM Quick Reference Sheet," provided instructions to the work control SROs and schedulers to perform risk evaluations using the PSAM. The schedulers performed the risk evaluations of out-of-service equipment configurations for maintenance as part of the finalization of the work schedule. Operations allowed work to be performed per schedule, and deviations were managed by the work week supervisors or by the shift managers after a risk evaluation in accordance with guidance in Section 4.7 of Administrative Instructions AI-255, "On-Line System Outage Preparation and Implementation", Revision 6, dated April 21, 1997. The operations staff interviewed were familiar with the use of the PSAM as an advisory tool for risk assessment of plant configuration changes, and aware of who to contact for aid in evaluating risk due to emergent equipment problems while other equipment was out-of-service.

The team's review of two months of control room logs showed good detail in the logs for the out-of-service and return-to-service times of equipment operability and maintenance activities. The site used the availability term as defined in CP-153B, "Monitoring the Performance of Systems, Structures and Components under the Maintenance Rule." This definition differed from the NUMARC 93-01 definition of availability during surveillance testing, and was used by the operators in logging the equipment as being available during surveillance tests. Section M1.6.b.7 contains additional information on this issue.

c. <u>Conclusions</u>

Licensed operators had an adequate understanding of the Maintenance Rule and understood their responsibilities for implementing the Maintenance Rule. The work control SROs, work week supervisors and schedulers were familiar with the use of the PSAM in support of work control activities.

<u>II. MAINTENANCE</u>

M1 Conduct of Maintenance

M1.1 <u>Scope of Structures, Systems, and Components Included Within the Rule</u>

a. <u>Inspection Scope (62706)</u>

Prior to the onsite inspection, the team reviewed the Crystal River Final Safety Analysis Report (FSAR), licensee event reports (LERs), the emergency operating procedures (EOPs), previous NRC inspection reports, and information provided by the licensee. During this review, the team selected a sample of SSCs that had not been classified in the scope of the Rule, but that appeared to the team to be SSCs that should be in the scope. During the onsite portion of the inspection, the team used this list to determine if the licensee had adequately identified the SSCs that should be included in the scope of the Rule in accordance with 10 CFR 50.65(b).

b. Observations and Findings

The licensee appointed an expert panel to perform several maintenance rule implementation functions including establishing the scope of the Maintenance Rule. The panel reviewed 129 systems and structures of which 98 were determined that were in the scope of the rule.

The team reviewed the licensee's Maintenance Rule data base in an effort to verify that all required structures, systems, and components were included within the scope of the Maintenance Rule. The team's review was performed to assure the scoping process included:

- all safety-related SSCs that are relied upon to remain functional during and following design basis events and ensure the integrity of the reactor coolant pressure boundary, the capability to shut down the reactor and maintain it in a safe shutdown condition, and the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the 10 CFR Part 100 guidelines;

- non-safety SSCs that are relied upon to mitigate accidents or transients;

- non-safety SSCs which are used in the plant emergency operating procedures;

- non-safety SSCs whose failure could prevent safety-related SSCs from fulfilling their safety-related function, and

- non-safety SSCs whose failure could cause a reactor trip or actuation of a safety-related system.

The team reviewed the licensee's Maintenance Rule data base and verified that all required SSCs were included in the rule with one exception. The licensee had not included the intake canal within the scope of the Maintenance Rule. This structure represented the ultimate heat sink for the site and provided the source of safety related cooling water for the plant. Additionally, the intake canal provided the source for circulating water to the main condenser and an unplanned reactor trip could result due to failure of this structure. The critical design parameters associated with the intake canal were described in FSAR Section 2.4.2.3. The team discussed this discrepancy with members of licensee management, and the team was informed that this structure should have been included in the scope of the Maintenance Rule. The licensee further informed the team that this problem would be added to the extent of condition for Precursor Card (PC) 98-2987 for inclusion in the Maintenance Rule. Although the structure had not been included in the scope of the Rule, the team determined that equivalent performance monitoring of this structure had occurred through another licensee program. Independent of the licensee's Maintenance Rule program, biannual inspections of the intake canal were performed to verify critical parameters were maintained and the structure had not degraded. This had been accomplished with Periodic Test, PT-501, Intake Canal Survey. Based on the low safety significance of this minor discrepancy, the licensee corrective actions for this isolated issue, and the reasonableness of licensee efforts to implement the Rule, the team concluded that the licensee appropriately met the intent of the Rule.

c. Conclusions

Required SSCs with the exception of one structure were included within the scope of the Rule.

M1.2 Safety or Risk Determination

a. Inspection Scope (62706)

Paragraph (a)(1) of the Maintenance Rule requires that performance monitoring and goals be commensurate with safety. Implementation of the Maintenance Rule, using the guidance contained in NUMARC 93-01, requires that safety be taken into account when setting performance criteria and monitoring under (a)(2) of the Rule. This safety consideration would then be used to determine if SSC functions be monitored at the train, system, or plant level. Also, Section 9.3.2 of NUMARC 93-01 recommends that risk-significant SSC performance criteria be set to assure that the availability and reliability assumptions used in the risk-determining analysis (i.e., PSA) are maintained. The team reviewed the licensee's methods for making these required safety determinations.

b. Observations and Findings

The team reviewed documentation associated with determining risk-ranking and performance criteria for the Maintenance Rule. Also, the team attended an expert panel meeting, and interviewed some of its members.

b.1 Risk Ranking

The licensee's PSA model used for risk ranking SSCs was based on the individual plant examination (IPE) submitted to the NRC, dated March 1993. The IPE study was a full scope, level 1 analysis for internal events (e.g., loss of offsite power, small or medium-break loss of coolant accidents, etc.). Generic failure data and plant-specific data for component failures from 1977 through 1989 were used in quantifying the IPE PSA model to produce a plant core damage frequency (CDF) estimate of 1.4E-5 per reactor-year. Changes to the PSA model were made to reflect plant design changes through May 1998, and also to enhance the modeling of common-cause failure contributions from safety-significant SSCs such as the emergency diesel generators, and the pumps for the makeup and emergency feedwater systems. Bayesian updating of plant-specific reliability data from 1989 through 1996 for major components were performed to update the database for PSA calculations. The licensee used a method of discretized distributions for the Bayesian updating of reliability data, and the results showed good approximations of the plant-specific data. The full quantification of the updated PSA model produced a CDF estimate of 6.7E-6 per reactor-year. This updated PSA model was used for the risk ranking of SSCs scoped in the Maintenance Rule, and as the basis for PSA Monitor computer evaluations used in planning equipment out-of-service schedules.

The team reviewed the truncation limits used during the risk-ranking process. Truncation limits were imposed on PSA models in order to limit the size and complexity of the results to a manageable level. The licensee performed a full requantification of the PSA model for the risk-importance calculations of each SSC. This approach eliminated the issue concerning truncation limits used in quantifying the PSA model for Maintenance Rule applications. The risk-importance measures calculated by the full requantification of the PSA model was considered to be a strength in the risk-ranking of SSCs for the Maintenance Rule.

The team reviewed a sample of SSCs covered by the Rule that had been categorized as non-risk significant to assess if the licensee had adequately established the safety significance of those SSCs. The determination of safety significance of SSCs was based on the combined results from PSA and deterministic considerations (i.e., expert panel judgment). The licensee used risk achievement worth (RAW), risk reduction worth (RRW), and 90 percent contribution to CDF as criteria for ranking the SSCs. The numerical risk-ranking given in the PSA analysis supported the decisions made by the licensee's expert panel. The expert panel upgraded 9 SSCs, which did not meet at least one of the PSA risk-significance criteria, into the high safety-significant (HSS) category. The 9 SSCs were the engineered safeguards (ES), core flood (CF), air handling units for reactor building recirculation (AH-XA), air handling units for control complex HVAC (AH-XK), reactor building spray (BS), diesel generator coolant (DJ), diesel generator lube oil (DL), containment isolation/penetrations (PE), and switchyard substation (SB) systems. The expert panel did not downgrade any SSCs from the high safety-significant (HSS) category to the low safety-significant (LSS) category. At the time of the inspection, the expert panel had declared 29 SSCs to be in the HSS category out of the 98 SSCs within the scope of the Rule. The team did not identify any SSCs that had been improperly ranked.

Based on this review, the team determined that the licensee's process was adequate to perform the risk ranking for the Maintenance Rule.

b.2 Performance Criteria

The team reviewed the licensee's performance criteria to determine if the licensee had adequately set performance criteria under (a)(2) of the Maintenance Rule. Section 9.3.2 of NUMARC 93-01 recommends that performance criteria for risk-significant SSCs be set to assure that the availability and reliability assumptions used in the risk-determining analysis (i.e., PSA) are maintained.

Based on interviews, the team found that the original estimates for performance goals were determined with input from the system engineers responsible for the specific equipment. The estimates were reviewed against historical information on the SSC performance, and forwarded to the PSA engineer and Maintenance Rule coordinator for review. Recommended changes were presented to the expert panel for approval. The licensee's program used reliability performance criteria that counted functional failures at the system level. Failures were assessed to determine if the system functions were affected, but not if they were maintenance preventable. The team observed that the reliability criteria varied from zero to one functional failure per two-years for risk significant SSCs. For non-risk standby SSCs, the reliability criteria varied up to four per 2-year rolling average. The method of establishing the functional failure criteria did not consider the reasonable estimate of demands for standby SSCs, and the accumulated operational time for the continuously operating SSCs. The team also noted that the unavailability criteria for several risk-significant SSCs (e.g., control complex HVAC, vital AC bus, chilled water system, and EDGs) were less stringent than the unavailabilities assumed in the PSA.

Also, the team reviewed an analysis titled "PSA Evaluation of Maintenance Rule Performance Criteria", transmitted by memorandum NSM98-0688, dated June 18, 1998. The analysis was a sensitivity study to determine the impact of the SSC performance criteria on the estimated mean CDF value. Both unavailability criteria and functional failure criteria of safety-significant SSCs were evaluated together to measure the change in the mean CDF estimate. The calculated CDF increase was about 89 percent above the plant baseline CDF. Given that the estimated plant CDF value was 6.7E-6 per reactor-year, this increase was not within the EPRI's PSA Guidelines for CDF incremental limit (i.e., about 39 percent) allowed for a risk-significant change. Although the performance of the risk-significant SSCs would not be simultaneously at the upper limits of the Maintenance Rule performance criteria, the sensitivity analysis results showed that the cumulative CDF increase falls in the category of "Further Evaluation Needed" based on the EPRI screening criteria for permanent changes impacting CDF. Additionally, the licensee' analysis was limited to evaluating the impact of SSC performance criteria for SSCs modeled in the PSA. In cases of non-risk significant standby SSCs which were not modeled in the PSA, the impact of the performance criteria of these SSCs would not be sufficiently evaluated. The licensee stated that the sensitivity analysis would be reperformed to demonstrate appropriate linkage.

The team concluded that the licensee-established performance criteria were not adequately linked to the PSA assumptions, which could result in failure of the established performance criteria to trigger consideration for (a)(1) monitoring requirements. The inadequacies in the sensitivity analysis and not adequately linking the performance criteria to PSA assumptions were considered weaknesses in establishment of performance criteria. Problems with performance criteria, including not adequately linking the performance criteria with PSA assumptions had been identified by the licensee in their corrective action program PC C97-6179 dated September 12, 1997). The corrective actions for the PC had not yet been completed (see section M7.1). This issue was identified as NRC Inspection Followup Item (IFI) 50-302/98-05-01, Linking Performance Criteria to PSA Assumptions, for further review after corrective actions for establishing the technical bases of the SSC performance criteria, i.e., linking the performance criteria to PSA assumptions, are completed.

b.3 Expert Panel

The team reviewed the licensee's process and procedures for the expert panel. The licensee had established an expert panel in accordance with the guidance provided in NUMARC 93-01. The expert panel's responsibilities included the final authority for decisions regarding Maintenance Rule scope, risk-significance, performance criteria selection, changing the classification of SSCs from (a)(2) to (a)(1), and making recommendations for changing (a)(1) SSCs to (a)(2).

The expert panel was comprised of personnel from operations, maintenance, work control, maintenance planning and scheduling, PSA group, and plant engineering. The team reviewed the qualifications of the expert panel and found that the panel members had over 175 man-years of plant and industry experience. A review of the documentation of expert panel meetings conducted since February 1998, showed that the meeting minutes provided detailed explanations for the basis of panel decisions. The expert panel used the Delphi approach in the deterministic considerations of SSC risk significance, and thus, the risk-significance determination process did not result in the improper ranking of SSCs.

The team attended an expert panel meeting conducted on June 24, 1998. The issues discussed in the meeting included scoping issues, the potential return of an (a)(1) system to (a)(2) status, the disposition of a system into the (a)(1) status and goal setting, and the PSA evaluation of Maintenance Rule performance criteria. The team noted a good discussion of the issues raised. The bases for all decisions were well documented.

c. Conclusions

The overall quantitative approach used to perform risk-ranking of SSCs for the Maintenance Rule was acceptable. The Delphi approach used in the expert panel decision-making on SSC safety significance did not result in any improper ranking of SSCs. The bases for all expert panel decisions were well documented.

Modeling problems in the sensitivity analysis and the licensee-identified problem of not adequately linking the performance criteria to PSA assumptions were considered weaknesses in establishment of performance criteria. IFI 50-302/98-05-01 was issued for further review of performance criteria after licensee corrective actions for establishing the technical bases of the SSC performance criteria, i.e., linking the performance criteria to PSA assumptions, are completed.

M1.3 Periodic Evaluation

a. Inspection Scope (62706)

Paragraph (a)(3) of the Maintenance Rule required that performance and condition monitoring activities and associated goals and preventive maintenance activities be evaluated taking into account, where practical, industry-wide operating experience. This evaluation was required to be performed at least one time during each refueling cycle, not to exceed 24 months between evaluations. The team reviewed the procedure the licensee had established to ensure this evaluation would be completed as required. In addition, the team discussed the requirements with the manager of systems engineering who is responsible for this activity. The team also reviewed the completed assessment, which was submitted to Region II, during the week of July 13, 1998, to determine if it met the requirements of 10 CFR 50.65, paragraph (a)(3).

b. Observations and Findings

The team verified that the licensee's procedure (Section 4.4 of CP-153A, "Maintenance Rule Implementation", Rev. 0) was in accordance with Section 12 of NUMARC 93-01. The team also verified that the current completed assessment, dated July 1, 1998, was in accordance with the guidance, which included review of: goals and monitoring, performance criteria, effectiveness of corrective actions, balancing of availability and reliability, the use of industry operating experience, and effectiveness of preventive maintenance program.

c. Conclusions

The (a)(3) periodic assessment met the requirements of paragraph (a)(3) of 10 CFR 50.65.

M1.4 Balancing Reliability and Unavailability

a. Inspection Scope (62706)

Paragraph (a)(3) of the Maintenance Rule required that adjustments be made where necessary to ensure that the objective of preventing failures of SSCs through maintenance was appropriately balanced against the objective of minimizing unavailability of SSCs due to monitoring or preventive maintenance. The team met with the maintenance rule coordinator, system engineers, and representatives of the maintenance rule working group and discussed the licensee's methodology for balancing reliability and unavailability.

b. Observations and Findings

The team reviewed the licensee's approach to balancing system reliability and unavailability for risk significant systems. The information and requirements for balancing reliability and unavailability was detailed in the following licensee procedures: 1) Compliance Procedure CP-153A, "Maintenance Rule Implementation" Revision 0, and 2) Compliance Procedure CP-153B, "Monitoring The Performance of Systems Structures And Components under The Maintenance Rule", Revision 1. The procedures followed the recommendations in NUMARC 93-01, Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants.

The licensee had scheduled balancing reviews during periodic evaluations at refueling outages, not to exceed 24 months. The system engineers were also required to perform a balancing review on a monthly basis. The licensee's approach consisted of monitoring SSC performance against the established SSC performance criteria. The process considered a function balanced if the performance criteria were met. The team considered this method in compliance with NUMARC 93-01.

In addition to review of the method used for balancing, the team reviewed the performance criteria for the 29 risk significant systems. Based on problems identified with performance criteria (see the IFI identified in Section M1.2.b.2 above) and the possible impact on balancing, the team questioned whether proper balancing could be performed for risk-significant systems with questionable performance criteria.

c. Conclusions

The team concluded that the licensee's approach of balancing reliability and unavailability met the intent of paragraph (a)(3) of the 10 CFR 50.65. However, it could not be determined if proper balancing was being performed since the performance criteria used for risk-significant SSCs were in question. Once corrective actions are complete to verify proper performance criteria, the process in place should ensure proper balancing.

M1.5 Plant Safety Assessments Before Taking Equipment Out-of-Service

a. Inspection Scope (62706)

Paragraph (a)(3) of the Maintenance Rule states that the total impact on plant safety should be taken into account before taking equipment out-of-service for monitoring or preventive maintenance. The team reviewed the licensee's procedures and discussed the process with plant operators, an operations manager, work control SROs, a scheduler, and the PSA engineer.

b. Observations and Findings

The team reviewed the licensee's process for removing equipment from service. The process was documented in Section 4.7 of Administrative Instructions AI-255, "On-Line System Outage Preparation and Implementation," Revision 6, for removing equipment from service while the plant is at full-power operation. When the plant is shut down for refueling outages, procedural guidance for removing equipment from service is provided in the following procedures: (1) NOD-49, "Management of Outage Nuclear Safety," Revision 1, (2) AI-502, "Defueled Plant Operations," Revision 3, and (3) AI-504, "Guidelines for Mode 5 Outages and Reduced Reactor Coolant Inventory Operations," Revision 8.

When the plant was at full-power operation, the PSA Monitor was used by schedulers, work week managers and work control SROs to evaluate plant risk for various equipment-outage configurations. A 12-week rolling schedule was used for planning surveillance and preventive maintenance of plant equipment. The work week supervisor and work control SROs stated that the PSA Monitor was used for evaluating emergent work situations (resulting from unanticipated equipment failures). For combinations of equipment outages not considered in the PSA Monitor, the operations staff would contact the PSA engineer to perform a detailed risk evaluation. The use of the PSA Monitor by the Operations and Maintenance staff for work planning was considered a strength in managing the risk control of changing plant configurations. However, the team noted that the impact of (1) switchyard maintenance, and (2) environmental conditions (e.g., weather, or electrical grid instability) on plant equipment out of service was not adequately modeled by the PSAM model. The team considered this PSAM modeling problem as a weakness in evaluating the risk-impact of multiple SSCs. The licensee intends to improve PSAM modeling by adding improved modeling techniques.

Shutdown risk was managed through the procedures: (1) NOD-49, "Management of Outage Nuclear Safety," Revision 1, (2) AI-502, "Defueled Plant Operations," Revision 3, and (3) AI-504, "Guidelines for Mode 5 Outages and Reduced Reactor Coolant Inventory Operations," Revision 8. The licensee plans to use the PSA software called equipment out-of-service (EOOS) Monitor for performing shutdown risk assessments. The use of the EOOS Monitor was expected to be implemented as of July, 1998. The PSA engineer would be involved in the risk assessment of emergent activities during the plant refueling outage to evaluate risk significance of the activities and potential compensatory measures.

As noted previously. 10 CFR 50.65 (a)(3) required an assessment of the total plant equipment that was out of service to determine the overall effect on performance of safety functions during the performance of monitoring and preventive maintenance activities. The team reviewed the control room logs over a two-month period to determine risk-significant "time windows" in which several SSCs were concurrently out of service. The review period was from March 1 through April 30. 1998. The team identified three instances in the Crystal River 3 operations logs (March 17. March 26. and April 27. 1998) where configurations of more than three SSCs were out-of-service. These equipment-outage configurations were due to planned maintenance and surveillance activities. The licensee was requested to evaluate the risk impact of the three equipment-outage configurations in terms of CDF estimates. The results of the risk evaluations indicated that there were no unacceptable risk due to the changed configurations during the sampled time period. Core damage probability estimates of the configurations were less than 1E-6 which was the risk impact threshold defined in EPRI's PSA Applications Guidelines.

c. Conclusions

The overall approach. under paragraph (a)(3) of the Rule. to assessing the risk impact to maintenance activities was acceptable. The use of the PSA Monitor for online risk evaluation of plant configurations was considered a strength. However. the impact of (1) switchyard maintenance. and (2) environmental conditions on SSCs being out of service was not adequately modeled by the PSAM model. This PSAM modeling problem was considered a minor weakness in evaluating the risk-impact of multiple SSCs.

M1.6 Goal Setting and Monitoring for (a)(1) SSCs

a. Inspection Scope (62706)

Paragraph (a)(1) of the Rule requires. in part. that licensees shall monitor the performance or condition of SSCs against licensee-established goals. in a manner sufficient to provide reasonable assurance the SSCs are capable of fulfilling their intended functions. The Rule further requires goals to be established commensurate with safety and industry-wide operating experience be taken into account. where practical. Also. when the performance or condition of the SSC does not meet established goals; appropriate corrective action shall be taken.

The team reviewed the systems and components listed below for which the licensee had established goals for monitoring of performance to provide reasonable assurance the system or components were capable of fulfilling their intended function. The team verified that industry-wide operating experience was considered, where practical, that appropriate monitoring was being performed, and that corrective action was taken when SSCs failed to meet goals or when a SSC experienced a maintenance preventible functional failure (MPFF).

The team reviewed program documents and records for four systems or components that the licensee had placed in the (a)(1) category in order to evaluate this area. The team also discussed the program with licensee management, the Maintenance Rule engineer, system engineers, and other licensee personnel.

b. Observations and Findings

b.1 Makeup and Purification System

The team reviewed portions of system MU, makeup and purification, during this inspection. The licensee had classified the system as safety related, normally operating with standby functions, and risk significant. This system had initially been classified as (a)(1) on April 8, 1996, due to repetitive seat leakage problems with MUV-103, MU system batch isolation valve. The licensee had subsequently also classified the MU System as (a)(1) on August 19, 1997, due to repetitive inadvertent closures of MUV-116, MU demin 1A isolation valve to letdown filter. The MUV-103 seat leakage problem had been a significant concern due to the potential for inadvertent dilution and subsequent unplanned reactivity changes, even though small in magnitude. As corrective actions for the MUV-103 seat leakage problem the licensee changed the design to allow use of a ball valve rather than the original split wedge gate valve and to install the new valve in a different location to allow better access for maintenance. Additionally, the licensee replaced a defective control switch for MUV-116.

The licensee had established goals of no unplanned reactivity changes as a result of seat leakage on the replacement valve for MUV-103 and no inadvertent closures or failures to close upon demand for MUV-116. The team verified that the licensee had implemented goal setting and monitoring as required by paragraph (a)(1) of the rule for the MU system.

b.2 Instrument Air

The licensee had classified the instrument air system as a Maintenance Rule non-risk significant system. Review of the problems associated with the system determined that appropriate corrective actions had been taken for failures. Operating experience was being used in system monitoring.

Review of the system scoping and performance criteria identified the following problem. The team noted that the instrument air system and the station air system were essentially one system with separate, non-identical performance criteria for each. At Crystal River the instrument air compressors and the station air compressors discharge to a common header. One of the station air compressors was primary. and the other station air and instrument air compressors function as automatic backups. which receive an automatic start signal based on low header pressure. Therefore. these two systems are essentially one system. with the various components having tag numbers for each of the two systems depending on component location and original design. This issue was presented to the licensee for resolution. Prior to the end of the inspection. the performance criteria for the two systems were combined and applied as one system. This problem had no technical affect on Maintenance Rule monitoring due to the fact that all failures had been previously recorded in a single data base. and the instrument air system had been previously classified as (a)(1) under the Rule.

Review of the corrective action. goals. and monitoring for the system identified an additional weakness concerning inadequacy in the documentation of the goals and monitoring. The corrective action for functional failures was addressed by many different corrective action documents. and the goals and monitoring. which involved significant design changes. had not been clearly defined in a corrective action document. This issue was presented to the licensee for resolution. Prior to the end of the inspection. the licensee issued Precursor Card 3-C98-3069. which adequately identified the goals and monitoring for the system. The team noted that the instrument air system had been placed in (a)(1) status prior to the Maintenance Rule implementation date in December 1994. In order to verify that this weakness in goals and monitoring for the instrument air system did not apply to other systems. and to verify the adequacy of current goals and monitoring practices. the team reviewed the goals and monitoring for all SSCs which had been placed in (a)(1) in 1998 (Reference precursor cards 3-C97-6814. 3-C97-8376. 3-C98-0827. and 3-C98-0972). These were found to be acceptable.

One additional weakness was noted concerning the reliability performance criteria for the instrument air system. The licensee used a reliability criteria of ≤ six (6) Maintenance Rule functional failures over a 24 month rolling average. At first glance this would lead one to believe that it would take 6 failures in order for the system to be evaluated for (a)(1) status. However. the rolling average concept. as used by the licensee. essentially equates to 12 failures in a 24 month period. Six failures for instrument air in a 24 month period may be a reasonable criteria. but 12 failures is excessively high. This weakness did not affect monitoring of the instrument air system due to the fact that it had been in an (a)(1) status since December 1994. However. all reliability criteria were established in this fashion. which led the team to question the appropriateness of the criteria as applied to all non-risk SSCs. Note: The rolling average concept was not applied to risk significant SSCs. The licensee had identified this issue during one of their self assessments. but had not completed corrective action at the time of this inspection (See Section M7.1 for additional details). As part of the corrective actions. the licensee planned to delete the rolling average concept for monitoring performance criteria.

b.3 AC Vital Bus (VB)

The AC vital bus system was classified as a risk significant safety system. The system consisted of four channels of safety-related 120 VAC power and two channels of non-safety-related power. Each channel consisted of input power from a 480/120 VAC transformer and a 120 VAC inverter through an automatic transfer switch to a 120 VAC bus. The inverter's input power was from the 125 VDC safety-related batteries.

The AC vital bus was classified as (a)(1), as a conservative measure, since there were repetitive component failures with the printed circuit control cards for the automatic transfer static switches. No system functional failures had occurred. The licensee had installed new type control cards for the failed cards and had scheduled replacing all the remaining cards as corrective action.

The (a)(1) performance goal to return the AC vital bus system to (a)(2) status was six successful transfers of the vital busses through the automatic transfer switches and no failures to transfer over the next 12 months during normal operation.

The team considered the licensee actions conservative based on: (1) classifying the system as (a)(1) based on repetitive failures, even though there were no functional failures, (2) taking appropriate corrective actions to replace the control cards with a new type, and (3) no failures of the performance criteria occurred. The team concluded the goals and corrective actions met the intent of the Rule.

c. Conclusions

For the (a)(1) SSCs reviewed, the licensee had established goals and monitoring. Safety had been considered in establishment of the goals and monitoring. Operating experience was being captured and industry wide operating experience was used. Corrective actions for improving the performance of (a)(1) SSCs were appropriate.

M1.7 Preventive Maintenance and Trending for (a)(2) SSCs

a. Inspection Scope (62706)

Paragraph (a)(2) of the Maintenance Rule states that monitoring as required in paragraph (a)(1) is not required where it has been demonstrated that the performance or condition of an SSC is being effectively controlled through the performance of appropriate preventive maintenance, such that the SSC remains capable of performing its intended function.

The team reviewed selected SSCs listed below for which the licensee had established performance criteria and was trending performance to verify that appropriate preventive maintenance was being performed, such that the SSCs remained capable of performing their intended function. The team verified that industry-wide operating experience was considered. where practical. that appropriate trending was being performed. that safety was considered when performance criteria were established. and that corrective action was taken when SSCs failed to meet performance criteria. or when an SSC experienced an MPFF.

The team reviewed program documents and records for selected SSCs that the licensee had placed in the (a)(2) category in order to evaluate this area. The team also discussed the program with licensee management. the Maintenance Rule coordinator. engineering and maintenance personnel. and other licensee personnel. In addition. the team reviewed specific program areas based on review of operator logs and equipment out of service logs.

b. Observations and Findings

b.1 Structures

The licensee's Maintenance Rule structural program was defined by Preventative Maintenance Procedure. PM-156. Revision 0. "Visual Inspection of Plant Structures". Using this procedure and the assistance of a contractor. the licensee had completed their baseline walkdown inspections of all structures scoped in the Maintenance Rule. The inspection results were documented in the "Maintenance Rule Structural Inspection Baseline Inspection" Report .dated October 17. 1997. The team reviewed Procedure PM-156. the inspection report. and the qualification of the inspection personnel who performed the walkdown. and found them acceptable. Although Procedure PM-156 was considered acceptable. the procedure had not been updated since its issuance in 1996. There were discrepancies between structure location descriptions on the master inspection list in the procedure and that on referenced drawings. Also. the procedure did not include the evaluation criteria data sheet used for the inspections. The licensee stated that the procedure would be updated to specify the drawing location descriptions and include the evaluation criteria data sheet.

The structures inspection report documented a very thorough and detailed inspection of all scoped structures. The report identified 806 items classified as "acceptable with deficiency" and 186 items classified as "unacceptable".

The majority of deficient and unacceptable items were related to loose or missing fasteners or bolts. At the time of the current NRC inspection. 183 of the 186 unacceptable items had been closed and three items remained open.

In addition to review of the procedure and inspection report. the team conducted a field inspection of the following structures: turbine building. intermediate building. control complex. heater bay. condensate storage tank. fire service tank. step-up transformer enclosures. intake structure, and wave embankment system. The inspection confirmed that the majority of the unacceptable items were closed, as documented in the licensee's records.

As an example of the thoroughness of the licensee's inspection, the team noted that walkdown personnel had identified that the top flange of a large steel beam, WF 36x152, supporting the deareator and storage tank, was torn from the web on one end and bent on the other end. The beam was located between two columns 26 feet above the floor. The damaged beam was replaced with a new beam. The team observed the new installed beam and the damaged one. The location of the damaged beam could not have been sighted with a casual inspection.

Based on the teams's inspection and review of records, the team concluded that the licensee had performed and documented a detailed and thorough inspection of Maintenance Rule scoped structures. This area was considered a strength.

b.2 Reactor Building Purge

System AH-XC, Reactor Building Purge, provided a ventilation exhaust flow path for the containment and has only been used by the licensee during outages. The purge isolation dampers were isolated and locked during power operation. However, the system also provided a post accident hydrogen vent function. The licensee had classified the system as safety-related and non-risk-significant. Review of system AH-XC determined that appropriate performance criteria had been established and monitoring was being accomplished against those criteria. Review of the problems associated with the system determined that appropriate corrective actions had been taken for failures. Operating experience was being used in system monitoring. No deficiencies were noted concerning this system.

b.3 Demineralized Water System

System DW, Demineralized Water System, provided the source of makeup demineralized water for various plant systems. The licensee had classified the system as normally operating and non-safety related. However, portions of this system were classified as risk-significant due to the ability to provide a backup source of water to refill the borated water storage tank following a steam generator tube rupture event. Review of system DW determined that appropriate performance criteria had been established and monitoring was being accomplished against those criteria. Review of the problems associated with the system determined that appropriate corrective actions had been taken for failures. Operating experience was being used in system monitoring. No deficiencies were noted concerning this system.

b.4 Feedwater System and FWP-7 Pump

The licensee had classified the feedwater system as a Maintenance Rule non-risk significant system. Review of the system determined that appropriate performance criteria had been established and monitoring was being accomplished against those criteria. Review of the problems associated with the system determined that appropriate corrective actions had been taken for failures. Operating experience was being used in system monitoring.

The team also reviewed feedwater pump seven (FWP-7), which was a standby SSC used in the event of a total loss of feedwater and a total loss of emergency feedwater. Credit was taken for this SSC in the licensee's PRA, and, as a result, the SSC was classified as a Maintenance Rule risk-significant system. Review of the system determined that appropriate performance criteria had been established, and monitoring was being accomplished against those criteria.

b.5 Substation System

The substation was classified as a safety-related, non-risk-significant system. Its maintenance rule function was to provide normal AC power from the 230kV and 500kV switchyard to the essential equipment. Review of the substation determined that appropriate performance criteria had been established and monitoring was being accomplished against those criteria. Review of the substation work orders and the plant list of deficiencies verified that the performance criteria were not exceeded, and the substation was properly classified as (a)(2). No problems were identified by the team for the substation. The team concluded that monitoring of the 230kV and 500kV substation met the intent of the Maintenance Rule.

b.6 DC Electrical System

The DC electrical system was classified as a risk significant, safety-related system. It included the 125/250 VDC batteries, battery chargers, and the 125 VDC distribution panels. Review of the DC electrical system determined that the performance criteria had been established and monitoring was being accomplished against those criteria. Review of the DC electrical system work orders and the plant list of deficiencies verified the performance criteria was not exceeded and the system was properly classified as an (a)(2). No problems were identified by the team for this system.

The team concluded monitoring of the DC electrical system met the intent of the Maintenance Rule.

b.7 Monitoring of Unavailability

The team reviewed the licensee's process for monitoring the performance of SSCs within the scope of the Maintenance Rule. The process was documented in Procedure CP-153B. "Monitoring the Performance of Systems. Structures. and Components under the Maintenance Rule." Revision 1. dated April 9. 1998. The team noted that the procedure guidance for tracking unavailability of SSCs during surveillance testing deviated from the NUMARC 93-01. Revision 2. definition. which does not allow taking credit for operator actions at any time for SSCs required to be available for automatic operation. The licensee's process allows not counting unavailability of SSCs during surveillances if the SSC could be restored to service with operator actions in a short time (i.e.. within minutes).

During the inspection. an automated keyword search of the operation's shift logs was made and identified approximately 15 SSC surveillances on 10 different equipment types in which no unavailability time had been counted for periods when the tested SSC had been removed from service for purposes of surveillance testing. Based on review of these surveillances. the team identified surveillance tests that were both safety-significant and would require multiple steps to restore SCC functionally. These surveillances were: SP-354A/B and SP-907A/B for monthly testing of EDGs and 4Kv ES bus undervoltage and degraded grid relays. respectively.

Specifically. both normal and emergency restorative actions in surveillance SP-907A/B require at least two operators (i.e.. two electricians in the ES 4KV switchgear room. and an operator and an electrician at the EDG) to perform several proceduralized actions to re-align the EDG to its normal operability status. The successful accomplishment of these proceduralized actions would take several minutes under ideal circumstances. Similarly. for SP-354A/B. several actions are required to restore the EDG to service. e.g.. defeat the trip function; set speed droop to 0; place EDG in "unit"; and verify the "unit/parallel" switch in the "unit" position. control switches are in auto position for the DC auxiliary fuel pump. the AC fuel transfer pump. the DC fuel transfer pump. and the AC air compressor. Based on a search of 1998 operator logs. the licensee determined that the total surveillance unavailability time for surveillances SP-354 and SP-907 has typically been 10 to 15 hours per month.

As stated in NUMARC 93-01. to the maximum extent possible. both availability and reliability should be used to provide the maximum assurance that performance is being monitored. The definitions as found in Appendix B of NUMARC 93-01 are provided to promote consistent interpretation of the Maintenance Rule. The term unavailability is defined as "an SSC that is required to be available for automatic operation must be available and respond without human action." Failure to count unavailability during surveillance testing is identified as Violation 50-302/98-05-02. Failure to Monitor SSCs Adequately Under the Maintenance Rule.

c. Conclusions

Generally. performance criteria were established. industry-wide operating experience was considered. where practical. operating data were being captured. appropriate trending was being performed. and corrective action was taken when SSCs failed to meet performance criteria or when a SSC experienced a maintenance preventable functional failure. However. a violation was identified for failure to count unavailability time during SSC surveillance testing.

Overall. the structures program was considered a strength. A detailed and thorough inspection of Maintenance Rule structures had been performed and documented.

M2 Maintenance and Material Condition of Facilities and Equipment

M2.1 Material Condition Walkdowns

a. Inspection Scope (62706)

During the course of the reviews. the team performed walkdowns of selected portions of the following systems and plant areas. and observed the material condition of these SSCs:

- Makeup and Purification System
- Instrument Air System
- AC Vital Bus
- Demineralized Water System
- Reactor Building Purge System
- Feedwater System including FWP-7 Pump
- 230kV and 500kV Switchyard Substation
- DC Electrical System
- Turbine Building
- Intermediate Building
- Control complex
- Heater Bay
- Condensate Storage Tank
- Fire Service Tank
- Step-up Transformer Enclosures
- Intake Structure
- Wave Embankment System
- Other Balance of Plant Areas

b. Observations and Findings

The team performed material condition walkdowns on selected portions of each system that related to the areas inspected. Housekeeping in the general areas around system and components was good. Piping and components were painted, and very few indications of corrosion, oil leaks, or water leaks were evident. The team did note a significant number of areas in the auxiliary building with paint peeling from walls. However, the licensee had a coatings program in process to correct this problem.

c. Conclusions

Generally, plant material condition observed during walkdowns was good.

M7 Quality Assurance in Maintenance Activities

M7.1 Licensee Self-Assessments

a. Inspection Scope (62706)

The team reviewed the following assessments and audits of the licensee's implementation of the Maintenance Rule:

- "Self Assessment of the CR3 Maintenance Rule Implementation Program", dated March 18, 1997
- "Nuclear Quality Assessments Audit 97-09", dated October 30, 1997
- Systems Engineering Self Assessment "Maintenance Rule Benchmarking", dated April 15, 1998
- Quality Programs Surveillance Report "Surveillance # QPS-98-0008", dated June 2, 1998

b. Observations and Findings

The team reviewed the listed audits and self-assessments and concluded that the licensee had done a thorough self-assessment of their program. The team also reviewed the corrective actions for these assessments which were documented in Precursor Card 3-C97-6179. The team determined that corrective actions were appropriate and were completed in a timely fashion with the exception of three issues. The licensee had identified that: 1) the Maintenance Rule performance criteria had not been adequately linked to the PRA; 2) scoping of shutdown functions needed additional review, and 3) confusion existed relative to the rolling 24 month averages for reliability performance criteria, which were being used to monitor SSC performance. The team noted that these issues had been known for over nine months, and licensee corrective action was only partially developed and implemented. This corrective action delay was considered a weakness.

c. Conclusions

Maintenance Rule audits and assessments were thorough. Corrective actions were adequate with the exception of three issues which had been identified but not resolved for over nine months. This corrective action delay was considered to be a weakness.

III. ENGINEERING

E2 Engineering Support of Facilities and Equipment

E2.1 Review of Updated Final Safety Analysis Report (UFSAR) Commitments (62706)

A recent discovery of a licensee operating their facility in a manner contrary to the UFSAR description highlighted the need for a special focused review that compares plant practices, procedures and/or parameters to the UFSAR descriptions. While performing the inspections discussed in this report, the team reviewed the applicable portions of the Crystal River UFSAR that related to the areas inspected. The team verified that the UFSAR wording was consistent with the observed plant practices, procedures and/or parameters.

E4 Engineering Staff Knowledge and Performance

E4.1 Engineering Knowledge of the Maintenance Rule

a. Inspection Scope (62706)

The team interviewed licensee system engineers for the SSCs reviewed in paragraphs M1.6 and M1.7 to assess their understanding of the Maintenance Rule and associated responsibilities.

b. Observations and Findings

System engineers demonstrated excellent knowledge of their systems and were proactive in corrective actions. Additionally, they understood specific requirements of the Maintenance Rule and how to apply the rule to their systems. The team considered the effective integration of assigned systems engineers in the process for implementation of the Rule as a major contributing factor to the program effectiveness noted during this inspection.

c. <u>Conclusions</u>

System engineers demonstrated excellent knowledge of their systems. were proactive in corrective actions. and had a good understanding of the Maintenance Rule requirements and how to apply the Rule to their systems. This area was considered a strength.

V. MANAGEMENT MEETINGS

X1 Exit Meeting Summary

The team leader discussed the progress of the inspection with licensee representatives on a daily basis and presented the results to members of licensee management and staff at the conclusion of the inspection on June 26, 1998. The licensee acknowledged the findings presented. At the time of the exit, Violation 50-302/98-05 was identified as an unresolved item. On July 16, 1998, the licensee was notified by phone that the unresolved item would be identified as a violation.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

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D. Miskiewicz, PSA Engineer and Expert Panel Chairman
C. Pardee, Director, Nuclear Plant Operations
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S. Cahill, Senior Resident Inspector
J. Jaudon, Division Director, Division of Reactor Safety

LIST OF INSPECTION PROCEDURES USED

IP 62706	Maintenance Rule
IP 62002	Inspection of Structures, Passive Components, and Civil Engineering Features a Nuclear Power Plants

LIST OF ITEMS OPENED, CLOSED, OR DISCUSSED

Opened

50-302/98-05-01	IFI	Linking Performance Criteria to PSA Assumptions (Section M1.2)
50-302/98-05-02	VIO	Failure to Monitor SSCs Adequately Under the Maintenance Rule (Section M1.7)

PARTIAL LIST OF DOCUMENTS REVIEWED

NUMARC 93-01, Revision 2, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants".

CP-153A, Revision 0, "Maintenance Rule Implementation".

CP-153B, Revision 1, "Monitoring the Performance of Systems, Structures and Components under the Maintenance Rule".

NOD-49, Revision 1, "Management of Outage Nuclear Safety".

AI-255, Revision 6, "On-Line System Outage Preparation and Implementation", dated April 21, 1997.

AI-502, Revision 3, "Defueled Plant Operations", dated March 31, 1997.

AI-504, Revision 8, "Guidelines for Mode 5 Outages and Reduced Reactor Coolant Inventory Operations," dated May 28, 1998.

"PSA Evaluation of Maintenance Rule Performance Criteria", transmitted by memo NSM98-0688, dated June 18, 1998.

PM-156, Revision 0, Visual Inspection of Plant Structures

PT-501, Revision 2, Intake Canal Survey